

REMARKS

Claims 41-51 and 60-73 are pending in this application, with claims 41, 46, 49, 60, 63, 66, and 71 being independent claims. Claims 71-73 have been allowed. Claim 69 has been amended to correct a minor typographic error. No new matter has been entered.

For the reasons detailed below, Applicant respectfully requests reconsideration and withdrawal of all of the objection and rejections set forth in the above-identified Office Action.

Claim Objection

In the Office Action dated August 8, 2003, claim 69 was objected to due to a minor typographic error. In response, Applicant has amended claim 69 to correct the error. Thus, Applicant respectfully requests reconsideration and withdrawal of this objection.

35 U.S.C. § 102 Rejections Based on Ou-Yand et al.

In the Office Action, claims 41-51, 60-62, and 66-70 were rejected under 35 U.S.C. § 102(e) as being anticipated by Ou-Yang et al. (U.S. Patent No. 6,379,574). In view of the following reasons, Applicant respectfully requests reconsideration and withdrawal of this rejection.

Independent Claims 41 and 46 and Their Dependent Claims

Each of independent claims 41 and 46 recites a plasma processing method comprising, among other things, "applying high-frequency power for biasing to the workpiece at a first power level," "raising the processing gas to a plasma," and "switching the high-frequency power for biasing applied to the workpiece from the first

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power level to a second power level lower than the first power level before the photoresist film becomes completely removed.”

As detailed below, Ou-Yang et al. cannot anticipate independent claims 41 and 46 because it does not disclose each and every method step recited in each of claims 41 and 46. In particular, Ou-Yang et al. does not disclose, among other things, a method step of “switching the high-frequency power [...] from the first power level to a second power level lower than the first power level before the photoresist film becomes completely removed,” as recited in each of claims 41 and 46.

Ou-Yang et al. discloses a post-etch treatment (PET) method performed after a dielectric etch process 40. The PET method includes two optional steps, i.e., flushing step 42 and cleaning step 46, as shown in Fig. 5. The flushing step 42 is performed after the dielectric etch process 40 and prior to the PET 44 to flush out fluorine species remaining in the processing chamber after the dielectric etch process 40 (See col. 6, lines 62-66). During the flushing step, no bias power is applied (See col. 7, lines 16-17). After the optional flushing step 42, the PET is performed, where the semiconductor structure is exposed to a plasma generated from a source gas comprising oxygen, a nitrogen-comprising gas, and a reactive gas to remove residues and polymers 62 in contact vias 60 (See col. 7, lines 31-40). The PET is performed with an applied biased power ranging from about 150 W to about 300 W (col. 8, lines 12-14). During the PET, any residual photoresist 58 remaining after the flushing step 42 is removed, as well as the remaining sidewall polymer, metal-comprising polymer 62, and the exposed portion of an anti-reflection layer 54 (See col. 8, lines 24-43). Following the PET 44, the cleaning step 46 is performed to remove any gases remaining in the reaction chamber

(See col. 9, lines 1-6). During the cleaning step 46, no bias power is applied (See col. 8, lines 64-65).

Relying on col. 7, lines 16-27, of Ou-Yang et al., the Examiner asserted that Ou-Yang et al. discloses the recited "switching" step because it discloses partially removing the photoresist when no bias power is applied to the substrate. The Examiner correctly identified that, during the flushing step 42, no bias power is applied and the photoresist layer 58 can be totally, or partially, removed. The Examiner, however, appears to have misunderstood the sequence of the Ou-Yang et al.'s PET method. As described above, the flushing step 42 is performed prior to the PET 44. During the PET 44, a bias power ranging from about 150 W to 300 W is applied. That is, Ou-Yang et al. switches the high-frequency power from the first power level (i.e., 0 W) to a second power level (i.e., 150 ~ 300 W), that is higher than the first power level, rather than the second power being lower than the first power level.

At least for this reason, Applicant respectfully submits that Ou-Yang et al. cannot anticipate independent claim 41 and 46 and their dependent claims. Thus, reconsideration and withdrawal of this rejection is respectfully requested.

Worth mentioning is that, with respect to claims 45 and 48, the Examiner asserted that Ou-Yang et al.'s disclosure in col. 6, lines 7-8, for forming a photoresist layer 58 on the substrate reads on the recited "organic film formed at the workpiece." Applicant respectfully traverses this ground of rejection. The photoresist layer 58 disclosed in, for example, col. 6, lines 7-8, of Ou-Yang et al. is different from the recited organic film layer. As recited in claims 41 and 46, the layer (i.e., organic film) is formed at a workpiece under a photoresist film, but there is no disclosure of such an organic

film layer in Ou-Yang et al. Thus, reconsideration and withdrawal of this ground of rejection is respectfully requested.

Independent Claims 49 and 60 and Their Dependent Claims

Independent claim 49 recites a plasma processing method comprising, among other things, "applying high-frequency power for biasing to the workpiece," "raising the processing gas to a plasma," "ashing the photoresist film while applying the high-frequency power for biasing to the workpiece," and "after the ashing step, stopping application of the high-frequency power for biasing before the photoresist film becomes completely removed, while utilizing the same type of processing gas both before and after stopping application of the high-frequency power." Similarly, independent claim 60 recites a plasma processing method comprising, among other things, "applying high-frequency power for biasing to the workpiece," "raising the processing gas to a plasma," "ashing the photoresist while applying the high-frequency power for biasing to the workpiece," and "after the ashing step, stopping the application of the high-frequency power for biasing before the photoresist film becomes completely removed."

The Examiner asserted that the cleaning step following the post-etch treatment reads on the recited step of "stopping application of the high-frequency power for biasing before the photoresist film becomes completely removed."

Prior to the cleaning step, however, the photoresist film 58 is already completely removed by the flushing step 42 and/or the PET 44. See, e.g., col. 7, lines 26-28, and col. 8, lines 34-36. That is, even though the cleaning step of Ou-Yang et al. may somehow be construed as performing "stopping application of the high-frequency power," the stopping occurs after the photoresist film became completely removed. Therefore, Ou-Yang et al. does not disclose the recited step of "stopping application of

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the high-frequency power for biasing before the photoresist film becomes completely removed,” as recited in each of claims 49 and 60.

Furthermore, claim 49 recites that the step of “stopping application of the high-frequency power” is performed “while utilizing the same type of processing gas both before and after stopping application of the high-frequency power.” The cleaning step of Ou-Yang et al., however, does not utilize the same type of processing gas used in the preceding PET. While the PET uses a source gas comprising oxygen, a nitrogen-comprising gas, and a reactive gas comprising hydrogen, carbon, and fluorine (col. 7, lines 32-36), the cleaning step utilizes only oxygen gas (col. 9, lines 1-6). Therefore, Ou-Yang et al. does not disclose the recited step of “stopping application of the high-frequency power for biasing [...] while utilizing the same type of processing gas both before and after stopping application of the high-frequency power.”

At least for these reasons, Ou-Yang et al. cannot anticipate independent claims 49 and 60 and their dependent claims. Thus, reconsideration and withdrawal of this rejection is respectfully requested.

With respect to claims 51 and 62, the Examiner appears to assert that the anti-reflection layer 54 is formed of an organic film. Applicant respectfully submits, however, that the anti-reflection layer 54 is not an organic film as disclosed in col. 8, lines 24-29, of Ou-Yang et al. Thus, reconsideration and withdrawal of this rejection is respectfully requested.

Independent Claim 66 and Its Dependent Claims

Independent claim 66 recites a plasma processing method comprising, among other things, “raising a processing gas to a plasma,” “applying a biasing power to the workpiece,” “removing the photoresist film substantially halfway with the fence portion,”

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“thereafter, stopping application of the biasing power with the photoresist film remaining,” and “thereafter, removing the photoresist film completely, while utilizing the processing gas same as the processing gas for removing the photoresist film substantially halfway.”

For the similar reasons set forth above in the discussion of independent claims 41, 46, 49, and 60, Ou-Yang et al. cannot anticipate independent claim 66 because, among other things, the photoresist film 58 of Ou-Yang et al. becomes completely removed during the flushing step 42 and/or the PET 44, prior to the cleaning step. See, e.g., col. 7, lines 26-28, and col. 8, lines 34-36. Moreover, the cleaning step of Ou-Yang et al. does not utilize the same type of processing gas used in the preceding PET.

At least for these reasons, Ou-Yang et al. does not disclose the recited steps of “stopping application of the biasing power with the photoresist film remaining,” and “thereafter, removing the photoresist film completely, while utilizing the processing gas same as the processing gas for removing the photoresist film substantially halfway.” Therefore, Ou-Yang et al. cannot anticipate independent claims 66 and their dependent claims. Reconsideration and withdrawal of this rejection is respectfully requested.

With respect to claim 70, similar to the reason set forth above in the discussion of claim 45, Applicant respectfully submits that there is no disclosure of an organic film layer in Ou-Yang et al. Thus, reconsideration and withdrawal of this rejection is respectfully requested.

35 U.S.C. § 103 Rejections Based on Tohda and Ou-Yang et al.

In the Office Action, claims 63-65 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Tohda (U.S. Patent No. 6,046,114) in view of Ou-Yang et al.

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In view of the following reasons, Applicant respectfully requests reconsideration and withdrawal of this rejection.

Independent claim 63 recites a plasma processing method comprising "etching a film by utilizing a resist film as a mask," "thereafter etching a film by utilizing a resist film as a mask," "thereafter removing the resist film substantially halfway with biasing power," and "thereafter removing the remaining resist film completely without applying any biasing power."

In the rejection statement, the Examiner alleges that "[s]ince Tohda is concerned with the step of removing the photoresist completely, one skilled in the art would have found it obvious to modify Tohda's method by performing the step of completely removing the photoresist without applying any bias power as per Ou-Yang because Ou-Yang states that no bias power is typically [applied] during the flushing step to totally remove the photoresist."

Applicant urges that such allegation cannot establish a *prima facie* case of obviousness under 35 U.S.C. § 103(a). To establish a *prima facie* case of obviousness, three basic criteria must be met. First, the prior art references when combined must teach or suggest all of the claim elements. Second, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Finally, there must be a reasonable expectation of success. M.P.E.P. § 2143. Furthermore, the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art, not in Applicants' disclosure. See In re Vaeck, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir.

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1991). Additionally, the evidence of a teaching, suggestion, or motivation to combine must be "clear and particular." In re Dembiczak, 175 F.3d 994, 999 (Fed. Cir. 1999). As will be described below, the alleged combination of Tohda and Ou-Yang et al. fails to establish a *prima facie* case of obviousness under 35 U.S.C. § 103(a).

In particular, as to the first criterion for a *prima facie* case of obviousness, the alleged combination of Tohda and Ou-Yang et al. does not disclose, teach, or suggest each and every element recited in claim 63. For example, neither Tohda and Ou-Yang et al., taken either alone or in combination, discloses, teaches, or suggests "removing the resist film substantially halfway with biasing power" and "thereafter removing the remaining resist film completely without applying any biasing power."

Nonetheless, relying on col. 4, lines 37-39, and Figs. 1(g) and 1(h) of Tohda, the Examiner alleged that Tohda discloses the recited steps of "removing the resist film substantially halfway with biasing power" and "thereafter removing the remaining resist film completely." Applicant respectfully disagrees with this allegation.

Tohda's disclosure relates to a method for producing a semiconductor device comprising forming of a film to be etched, an organic antireflective film, and a resist mask on a substrate and, before etching the film to be etched, dry-etching of the organic antireflective film. That is, Tohda's disclosure concerns mainly on preparation of antireflective film for use as a resist mask, the method of which must be performed prior to the actual etching of the film to be etched, i.e., pre-etching process.

The Examiner appears to have misunderstood the teachings of Figs. 1(g) and 1(h), such that the state of semiconductor device shown in those figures illustrate the recited steps of "removing the resist film substantially halfway with biasing power" and

"thereafter removing the remaining resist film completely," after "etching a film by utilizing a resist film as a mask." However, Figs. 1(g) and 1(h) instead illustrate a reworking process in an abnormal condition, where a defect is found in the resist mask 7. In such a case, Tohda discloses that the resist mask 7 and antireflective coating pattern 8 are removed from the substrate by a 100% over-ashing process, rendering the substrate ready for reworking. See, e.g., col. 5, lines 27-35. It is also evidently clear from Figs. 1(g) and 1(h) that no etching has yet been performed on the substrate.

Furthermore, even if Figs. 1(g) and 1(h) could be interpreted as teaching a post-etching process, there is no disclosure of the recited steps of "removing the resist film substantially halfway with biasing power" and "thereafter removing the remaining resist film completely." While the Examiner appears to allege that Fig. 1(g) shows the recited step of "removing the resist film substantially halfway with biasing power," Fig. 1(g) merely shows an intermediate state between the substrate states shown in Figs. 1(f) and 1(h) during the ashing process of the resist mask 7 and antireflective pattern 8. There is absolutely no disclosure in Tohda of stopping or switching a biasing power after removing the resist film substantially halfway.

At least for these reasons, the first criterion for a *prima facie* case of obviousness has not been met.

As to the second criterion, there is no suggestion or motivation in the aforementioned references to combine or modify the teachings of the references. In other words, it is unclear why one of ordinary skill in the art would have been motivated to take the teachings of Ou-Yang et al. of a post-etching treatment method, and apply them to the teachings of Tohda that concern mainly a pre-etching process.

Furthermore, the Examiner also has failed to provide any evidence showing that such suggestion or motivation is in the knowledge generally available to one of ordinary skill in the art. Therefore, the second criterion for a *prima facie* case of obviousness also has not been met.

Finally, as to the third criterion, not only does the alleged combination of Ou-Yang et al. and Tohda fail to teach or suggest the claimed invention, the alleged combination does not show a reasonable expectation of success because it is unclear as to how the post-etching treatment method of Ou-Yang et al. could be incorporated into the pre-etching process of Tohda. In addition, neither a teaching or suggestion to make the alleged combination nor a reasonable expectation of success is found in Ou-Yang et al. or Tohda. Therefore, the third criterion for a *prima facie* case of obviousness also has not been met.

At least for these reasons set forth above, the alleged combination of Ou-Yang et al. and Tohda fails to establish a *prima facie* case of obviousness under 35 U.S.C. § 103(a). Therefore, reconsideration and withdrawal of this rejection is respectfully requested.

In view of the foregoing remarks, Applicant respectfully submits that all of the pending claims define novel and non-obvious subject matter over the cited references. Therefore, Applicant respectfully requests reconsideration of this application and the timely allowance of all pending claims.

The Office Action contains a number of statements and characterizations regarding the claims and the related art. Applicant declines to subscribe automatically

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to any statement or characterization in the Office Action, regardless of whether it is addressed above.

Please grant any extensions of time required to enter this response and charge any additional required fees to our deposit account 06-0916.

Respectfully submitted,

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Dated: November 7, 2003

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